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I, LEANNE MYNOTT, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PQ 0175 for a patent by VICTORIAN CHEMICALS INTERNATIONAL PTY LTD filed on 05 May 1999.

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Twenty-third day of May 2000

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AUSTRALIA

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PROVISIONAL SPECIFICATION

Invention title: ADJUVANT COMPOSITION FOR CHEMICALS USED IN AGRICULTURE

The invention is described in the following statement:

Field of the invention

The invention relates to an adjuvant for use with chemicals used in agriculture. More particularly, the adjuvant of the invention is particularly adapted for use with herbicides.

Background of the invention

Whilst the following discussion highlights the invention with relation to herbicides, it is believed that the same principles apply to other chemicals used in agriculture, such as, plant hormones, insecticides, crop desiccants or crop defoliants.

Farmers rotate the use of their fields to allow the fields to regain their fertility. This means that at any one time there will be fields with crops and fields left bare. The bare fields are said to be fallow fields.

Weeds will still grow on the fallow fields, and while they will not be competing with a crop for nutrients or space, if they are left alone they will produce many seeds which will germinate and be problematic when the field is again used for crops. As a result, the farmer will spray the fallow fields with herbicide to kill the weeds. Since there is no crop on fallow fields, a non-selective herbicide can be used, such as glyphosate.

There is a growing trend to produce adjuvants to improve the efficacy of agrochemicals, including herbicides. For example, in Australian patent application number 62833/98, an adjuvant for use with herbicides, crop defoliants and desiccants is disclosed including esters of fatty acids and nonionic emulsifiers.

Currently, the farmer may prepare the glyphosate spray with several additives to improve its efficacy. For example, it is known to add ammonium salts to improve the efficacy of glyphosate. The reasons for this improvement are not well understood and it is a complicated area of chemical and botanical reactions. However, it is believed that the anion in the salt minimises the deleterious effect of hard water on herbicidal performance and the ammonium cation provides nutrition for the plant which enhances the take up and translocution of the herbicide by the plant. Wetting agents are also used to improve leaf coverage. Petroleum fractions or other lipids are used, especially in the

summer months, to keep the herbicide in liquid form as the herbicide will be ineffective once it dries on the foliage.

The farmer may combine all these additives with the herbicide when the tank mix is prepared but the farmer may not know whether these components are compatible with each other. Some additives or adjuvants can actually antagonise each other and decrease the activity of the agrochemical. It is also inconvenient since there are several components which must be bought, measured and combined.

It is envisaged that incorporating ammonium salts into lipid-based adjuvants will produce an adjuvant which provides active ingredient enhancement in several different ways. It is thought that the ammonium salts (a source of nitrogen) would provide the weeds with a growth spurt through the fertiliser effects and could also increase leaf permeability whilst the lipids would improve the transport of the active to the target. However, this has not been possible to evaluate because the ammonium salts are not soluble in lipids and a homogeneous blend cannot be easily achieved.

Farmers are always looking for more efficacious and convenient ways to enhance active ingredients. They would also prefer to simply add one composition which they know will enhance the efficacy of the herbicide rather than deal with several components where the resultant effect is unknown.

Object of the invention

It is an object of the present invention to provide an adjuvant for use with chemicals used in agriculture to increase their efficacy.

Summary of the invention

It has surprisingly been found that a homogeneous blend which is stable within normal storage conditions can be made which includes lipids and plant nutrients (e.g. ammonium salts). It has further been surprisingly found that this homogeneous blend enhances the activity of the chemicals used in agriculture more than merely separate mixing of each individual additive to the chemicals used in agriculture at their normal use rates.

According to one preferred form of the invention an adjuvant for use with a chemical used in agriculture is provided comprising:

(b) not in excess of about 50% by weight of one or more plant nutrients (e.g. ammonium salts of inorganic anions); and

(c) not in excess of about 50% of a mixture of one or more cationic emulsifiers.

The lipids may be petroleum fractions, vegetable oils, synthetic triglycerides, alkyl esters of fatty acids, fatty alcohols, guerbet alcohols or any combination thereof. Preferably, a petroleum fraction is used as it is more cost effective. More preferably, the petroleum fraction is a mineral oil. These mineral oils, for example, can be 70, 100 or 150 sec solvent neutral.

If alkyl esters of fatty acids are used then the higher levels of unsaturated fatty acids are preferred, being more effective as surface modifiers. There are innumerable variations of the esters of fatty acids which may be produced from the natural oils and fats such as lard, tallow and vegetable oils, such as canola, corn, sunflower and soyabean oils, or from specific blends produced by fatty acid manufacturers or from fatty acids produced by synthetic means..

The plant nutrients include ammonium salts of inorganic anions (such as ammonium sulphate and phosphates) which are known to minimise the deleterious effects of hard water on herbicide performance. Preferably, the ammonium salt is ammonium sulphate. If an anhydrous ammonium salt is used then water may need to be added to the composition. However, if the ammonium salt is already in solution then additional water will probably not be necessary.

The cationic emulsifiers are well known to those skilled in the art, and it is recognised there are a multitude of combinations. Preferably, the cationic emulsifiers are quaternary cationic emulsifiers, for example, alkyltrimethylammonium chloride, alkyl dimethylbenzylammonium chloride, alkylpyridium chloride, or alkylimidazolium chloride. More preferably, the cationic emulsifiers are fatty quaternary ammonium chlorides.

When esters of fatty esters are used as the oil, preferably, a mixture of at least two cationic emulsifiers are used. One of the cationic emulsifiers may be an amphoteric emulsifier acting as a cationic emulsifier. More preferably, the mixture of cationic emulsifiers comprises fatty quaternary ammonium chlorides and fatty alkyldimethylamine salts of

simple organic acids. For example, the fatty alkyldimethylamine salts of simple organic acids could be cocodimethylamine or lauryldimethylamine with citric acid. Other simple organic acids include acetic, 2-ethylhexanoic acid, tartaric, maleic and lactic acid.

In another preferred form of the invention, the adjuvant for use with a chemical used in agriculture further comprises one or more other available adjuvant components.

The adjuvant component may be selected from nonionic emulsifiers, co-solvents, pH modifiers, spray drift retardants, and wetters.

Preferably, the nonionic emulsifiers are alkyl polysaccharides, sorbate emulsifiers or fatty alkanolamides. Alkyl polysaccharides are sometimes called alkyl polyglucosides, alkyl glucosides or alkyl saccharides. The alkyl group can be, for example, octyl, decyl, dodecyl or even mixtures. The sorbate emulsifiers are sorbitan mono- (or sesqui-)esters of fatty acids and include sorbitan mono-oleate and sorbitan monolaurate. Preferably, the sorbate emulsifier is sorbitan mono-oleate. An example of a fatty alkanolamide is oleyldiethanolamide. The co-solvents include propylene glycol, 1,3-butylene glycol, hexylene glycol, polypropylene glycols and ethanol.

When mineral oils are used, preferably, the mixture of emulsifiers comprises a quarternary cationic emulsifier, alkylpolysaccharides and sorbitan mono-oleate.

Examples

The invention will now be further explained and illustrated by the following non-limiting examples.

Glyphosate CT solution produced by Nufarm.

BS 1000 is alcohol alkoxylate produced by Cropcare.

WINTER OIL is produced by BP.

Prorex 36 is a 100 sec solvent neutral mineral oil produced by Mobil.

Ammonium sulphate is in a liquid form supplied by Nufarm and called LIASE.

Ethyl oleate was supplied by Victorian Chemical Company and contains approximately 80% w/w ethyl and 20% w/w methyl esters of canola oil.

Ammonium nitrate was used with urea and supplied by Orica.

Company, USA.

Span 80 is sorbitan mono-oleate supplied by Huntsmen Corporation Australia.

Radiaquat 6465 is lauryl trimethyl ammonium chloride in a 30% solution supplied by Fina Chemicals Belgium.

Alkadet 15 is an alkyl polysaccharide Huntsmen Corporation Australia.

Quatramine C16/29 is a 29% solution of cetyltrimethylammonium chloride supplied by APS Chemicals.

Vicamid 825 is oleyldiethanolamide produced by Victorian Chemical Company.

Ethanol was supplied by CSR and contained 2-3% methanol.

The following compositions were tested by adding the components shown to a water-based tank mix. The spray tank mixture was applied to the plants at a rate equivalent to 64 litres/hectare. The glyphosate used was the commercially available Glyphosate CT at a rate equivalent to either 60 g a.i / hectare or 120 g a.i / hectare (See test results to follow). The adjuvants were added volumetrically to the tank mix as a percentage of the tank mix volume. The individual components of the adjuvant formulations are shown as percentage by weight.

Table 1: Compositions tested.

Composition	Components
1.	unsprayed control
2.	glyphosate alone
3.	glyphosate with 0.2% BS 1000
4.	glyphosate with 1.0% Winter Oil
5.	glyphosate with 2.0% ammonium sulphate
6.	glyphosate with 0.2% BS 1000, 1.0% Winter Oil and 2.0 % ammonium sulphate

Composition	Components
7.	glyphosate with 0.75% of an adjuvant composed of 28 Prorex 36, 10 Span 80, 16 ammonium nitrate solid, 12 urea, 16 water, 12 Radiaquat 6465, 3 Alkadet 15 and 3 ethanol.
8.	glyphosate with 1.5% of an adjuvant composed 28 Prorex 36, 10 Span 80, 16 ammonium nitrate solid, 12 urea, 16 water, 12 Radiaquat 6465, 3 Alkadet 15 and 3 ethanol
9.	glyphosate with 0.75% of an adjuvant composed of 22 Prorex 36, 7 Span 80, 11 Radiaquat 6465, 17 ammonium suphate, 39 water and 4 Alkadet 15.
10.	glyphosate with 1.5% of an adjuvant composed of 22 Prorex 36, 7 Span 80, 11 Radiaquat 6465, 17 ammonium suphate, 39 water and 4 Alkadet 15.
11.	glyphosate with 0.75% of an adjuvant composed of 5 potassium ammonium phosphate, 7 Alkadet 15, 10 Radiaquat 6465, 26 Prorex 36 and 7 Span 80. (Note, no water was added but there was a water content of about 30%)
12.	glyphosate with 1.5% of an adjuvant composed of 50 potassium ammonium phosphate, 7 Alkadet 15, 10 Radiaquat 6465, 26 Prorex 36 and 7 Span 80. (Note, no water was added but there was a water content of about 30%)
13.	glyphosate with 0.75% of an adjuvant composed of 47 potassium ammonium phosphate, 6 Alkadet 15, 9 Radiaquat 6465, 25 ethyl oleate, 6 Span 80 and 6 water.
14.	glyphosate with 1.5% of an adjuvant composed of 47 potassium ammonium phosphate, 6 Alkadet 15, 9 Radiaquat 6465, 25 ethyl oleate, 6 Span 80 and 6 water.

The above compositions were tested on spiny emex shoots which is a broad leaf weed. The fresh weight (grams) of the weeds were measured 31 days after the spray application. The glyphosate was applied at 60g a.i./ha and 120 g a.i./ha which is 12.5% and 25% respectively of the normal application rate.

Table 2: Test results with spiny emex shoots

Composition	Fresh weight (g)	
	(60 g/ha glyphosate)	(120 g/ha glyphosate)
1.	15	n/a
2.	14	10
3.	13	9
4.	12	7
5.	11	7
6.	13	9
7.	12	5
8.	11	5
9.	8	4
10.	6	3
11.	11	7
12.	7	4
13.	9	3
14.	5	4

Analysis

Example 1 illustrates that compositions 7 to 14 are more efficient than glyphosate alone or the mere combination of the commonly used amounts of additives in composition 6.

Therefore, the invention provides an adjuvant for a herbicide in a single composition which performs surprisingly better than the mixture which a farmer would obtain if the commonly used additives were simply mixed together in the tank mix.

Example 2

The above compositions were tested on ryegrass shoots. The fresh weight (grams) of the weeds were measured 19 days after the spray application. The glyphosate was applied at 60g a.i./ha and 120 g a.i./ha which is 12.5% and 25% respectively of the normal application rate.

Table 3: Test results for ryegrass shoots

Composition	Fresh weight (g)	
	(60 g/ha glyphosate)	(120 g/ha glyphosate)
1.	4	n/a
2.	3	2
3.	3.75	0.75
4.	3.5	0.75
5.	2	1
6.	2	1
7.	3.5	1.5
8.	2.75	1
9.	1.75	0.5
10.	1.25	0.25
11.	1.75	0.5
12.	1.75	0.25
13.	2.25	0.25
14.	1.25	0.25

Example 2 illustrates that compositions 9 to 14 are more efficient than glyphosate alone or the mere combination of the known amounts of additives in composition 6. Compositions 9 to 14 produce surprisingly good results when used with 120 g/ha of glyphosate, which is one quarter of the normal application rate.

Example 3

Further investigations into producing a more stable adjuvant mixture were performed on the adjuvant used in Compositions 9 and 10 above. All proportions are by weight.

Component A: Mix together 22% of Prorex 36 with 7% of Span 80.

Component B: Mix together 11% Radiaquat 6465, 17% ammonium sulphate, 38% water, and 4% Alkadet 15.

Component B was added to Component A slowly with stirring. Then 1% of Vicamid 825 (oleic diethanolamide) was added with stirring until cloudiness disperses. Some filtration may be necessary to remove insoluble matter formed from the reaction of anionic emulsifiers present in Span 80 and Prorex 36 with the cationic emulsifiers.

This formulation provided a more stable homogeneous blend than the adjuvant used in Compositions 9 and 10 above.

Example 4

This example investigated the addition of another typical adjuvant component. BIVERT concentrate is the active ingredient of BIVERT which is a spray drift retardant supplied by Wilbur-Ellis Company.

The following compositions were prepared as homogeneous blends. All proportions are by weight. All the ingredients except for the citric acid were stirred together. Then enough citric acid was then added with stirring to clear the mixture and give high temperature stability.

Each of the examples 1, 2 and 3 in Table 4 were found to be homogeneous blends.

Table 4: Composition with spray drift retardant

	1	2	3
Potassium ammonium phosphate	20	20	-
Ammonium sulphate	-	-	10
Water	10	10	20
Ethyl Oleate	30	30	30
BIVERT concentrate	10	10	10
Dimethyl laurylamine	10	10	10
Alkadet 15	5	5	5
Radiaquat 6465	5	-	-
Quatramine C16/29	-	6	6
Vicamid 825	5	4	4
Propylene Glycol	5	3	3
Citric acid	2	2	2

The word 'comprising' and forms of the word 'comprising' as used in this description does not limit the invention claimed to exclude any variants or additions which would be apparent to persons skilled in the art at the time of reading the specification.

Modifications and improvements to the invention will be readily apparent to those skilled in the art. Such modifications and improvements are intended to be within the scope of this invention.

Victorian Chemicals International Pty Ltd **5 May, 1999**